Transformational Communications Systems for DoD Net-Centric Operations

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The Department of Defense (DoD) is moving ahead to establish the next generation of warfighting communications capabilities needed for global net-centric operations. The key programs that make up this new capability are the Transformational Satellite Communications System (TSAT), the Joint Tactical Radio System (JTRS), and the Defense Information Systems Network – Next Generation (DISN-NG). These programs will greatly enhance the ability of the DoD to share information – in real-time if required – improve command and control, and ultimately transform DoD operations. This article provides an update on the DoD's communications programs vision and status of the TSAT, JTRS, and DISN-NG programs.

The foundation for U.S. and coalition net-centric operations is the communications network. This vital *transport* system allows critical warfighter information to be shared real-time and will enable global net-centric operations. The heart of the Department of Defense's (DoDs) long term integrated investment strategy is a network of systems providing greatly enhanced capabilities for all aspects of U.S. national security activities. This includes persistent surveillance, distribution of detailed actionable intelligence, and support to precision strike. It also includes secure, protected, networking-on-the-move (NOTM) communications capability to support enhanced command and control of forces. This capability supports not only tactical forces, but also all other national security operations, including logistics, business operations, and intelligence functions. Several key programs will be integrated to provide an end-to-end communications capability to support net-centric operations (Figure 1). The key programs within these areas are the Transformational Satellite Communications System (TSAT), the Joint Tactical Radio System (JTRS) and the Defense Information Systems Network-Next Generation (DISN-NG) (Figure 2).

Transformation Satellite Communication System (TSAT)

TSAT is the cornerstone of the DoD's future communications network and provides real-time global reach. It is the spaceborne element of the Global Information Grid (GIG), and it enables secure, protected, networked, bandwidth-on-demand communications connectivity to fixed/mobile strategic and tactical users. The Army's *Future Force*, Navy's *SeaPower 21*, and Air Force's *Air Expeditionary Force* rely on the transforming capabilities of flagship systems including the Army's Future Combat System and Warfighter Information Network-Tactical, the Air Force's Space Based Radar (SBR) system, and the various Unmanned Aerial Vehicle platforms. The full capability of these systems depends on the space-based network connectivity TSAT will provide.

TSAT is the next generation of satellite communications (SATCOM) system and represents an advancement from the

Figure 1: *Communications Components*

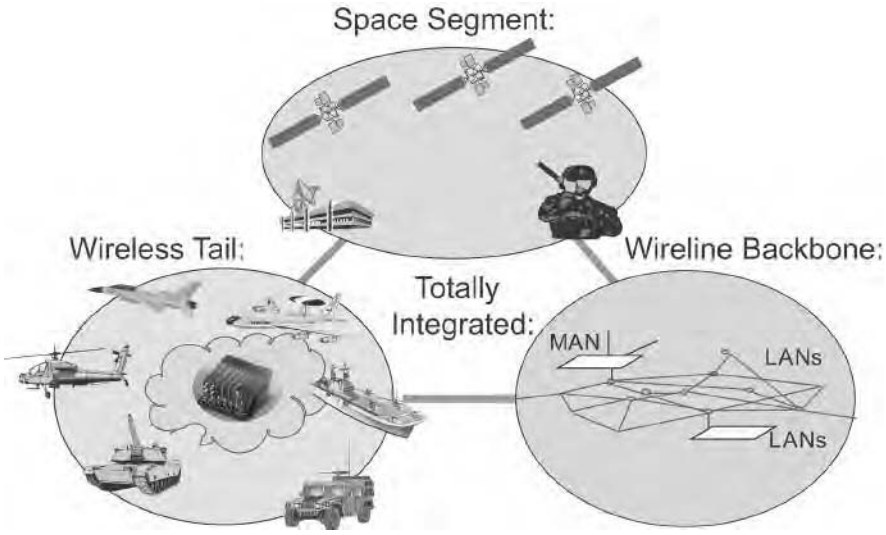
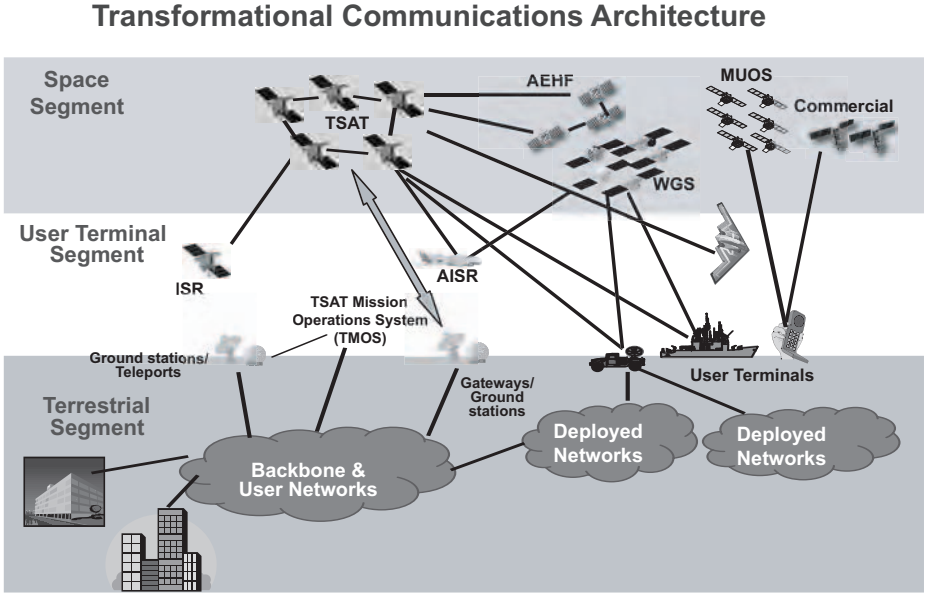


Figure 2: *Transformational Communications Architecture*



current circuit based systems such as Milstar, Advanced Extremely High Frequency, and Wideband Gapfiller System, to a fully networked system providing dramatically improved connectivity across the GIG. In addition, TSAT provides significant increases in data rates to small and large terminals enabling high data rate *protected* NOTM and support to airborne and spaceborne Intelligence, Surveillance, and Reconnaissance communications capabilities (e.g. SBR and Global Hawk). Figure 3 shows the evolution of capabilities from one generation of space systems to the next. For example, NOTM is one of the key new requirements that TSAT meets. This basic requirement is to be able to dynamically reconnect to a vehicle moving at 40 miles per hour with a 1.5 megabit per second (T1) communications link. This vehicle would have a one foot antenna. Only TSAT can meet this critical warfighter requirement.

The TSAT program made significant progress in fiscal year (FY) 2005. Given the Congressional direction resulting from the FY 2005 appropriated budget, the program renewed its focus on maturing the key subsystem technologies and plans to continue this focus through maturation to Technology Readiness Level-six (TRL-6) and beyond. The program office is verifying TRL status via testing of contractor developed hardware in an independent government testbed. In addition to technology maturity, these tests will demonstrate integrated performance of the TSAT system and support systems design activities. In FY 2005, three of the six key technologies were matured to TRL-6, and the remaining three technologies are on track to achieve TRL-6 prior to the award of the system development contract, an earlier point than achieved by previous space programs.

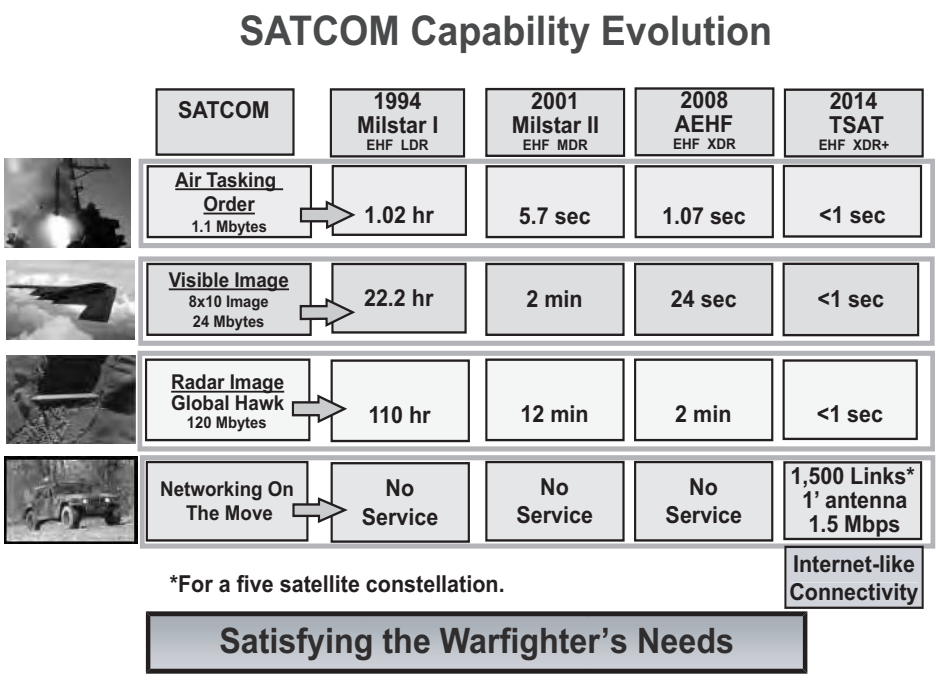
As part of the Quadrennial Defense Review, the DoD evaluated both the TSAT Program of Record (PoR) and a Block Build excursion from the PoR. The Block TSAT program delivers incremental capabilities in two blocks. In Block 1, the complexity and size of the payload are reduced significantly with respect to the PoR, and will simultaneously lower the development and integration risk. Taking a *smaller step* on the Block 1 satellites increases DoD confidence in launching these satellites on schedule and allows learning and performance to guide the Block 2 development.

The Undersecretary of the Air Force has made this block approach the model for other space programs to follow. We believe this new development paradigm will enable our ultimate goal – to efficiently acquire and deliver space systems that provide unique capabilities to our warfighter.

Joint Tactical Radio System

The JTRS program was initiated in early 1997 in response to the Services' pursuit of separate solutions to a programmable, modular, multiband, multimode radio that would eventually replace over 200 radio types in the DoD inventory. It is now considered the single DoD-wide approved program that will provide the next generation family of tactical radios to the warfighter with not only greatly expanded capabilities, but also increased interoperability through the incorporation of both existing and advanced waveforms. The family of radios will be scalable by virtue of form, fit and cost and will be expandable using the open software communications architecture (SCA) standard. The family will consist of three domains: airborne, ground, and maritime/fixed station. These domains are supported by five radio families (or *clusters*) to include handheld, man-packed, vehicular mounted, airborne and maritime/fixed station. JTRS lays the foundation for achieving net-centric connectivity across the below two gigahertz radio frequency spectrum. It provides the means for digital information exchanges between joint warfighting elements and enables connectivity across all domains of warfare – land, air, and maritime and also to civil and national authorities. JTRS also supports the need to share real-time information among joint warfighters and enables joint and combined interoperability and will support self-organizing, mobile, networked forces on-the-move. Using gateways if necessary, JTRS users can connect to other users beyond their line of sight via SATCOM. The SATCOM links then connect into the GIG, thus giving JTRS users on the front lines access to any information stored anywhere on the GIG.

Figure 3: *SATCOM Capability Evolution*



JTRS Waveforms. JTRS waveforms are managed by the JTRS Waveforms Program Office (JWPO). The purpose of the JWPO is to define, develop, validate, and evolve the JTRS SCA; acquire waveform software applications; acquire Crypto Equipment Applications; and perform architecture compliance testing of both JTR sets and waveform software.

JTRS Cluster 1 Program. The JTRS Cluster 1 Progam provides for development and production of the ground vehicular configurations of the JTRS radio family.

JTRS Cluster 2 Program. The JTRS Cluster 2 Program provides for development and production of a single channel JTRS handheld radio. This Cluster will modify the current MultiBand Intra-Team Radio (MBITR) for crypto and SCA compliance within the current spec-

trum parameters of the MBITR radios. This new version of the MBITR will be called the JTRS Enhanced MBITR or (JEM). Cluster 2 serves as an interim handheld until a JTRS Operational Requirements Document (ORD)-compliant two-channel, handheld, and man-pack radio that operates over the full JTRS spectrum is developed in Cluster 5.

JTRS Cluster Airborne, Maritime, Fixed/ Station (AMF). JTRS Cluster AMF provides for development and production of the airborne, maritime, and fixed family of JTRS radios. This program is still in a pre-system development and demonstration phase. Current plans call for award of the developmental contract in late 2006 (Cluster AMF combined the original Cluster 3 and Cluster 4).

JTRS Cluster 5 Program. The JTRS Cluster 5 Program provides for development and production of the handheld, man-pack and small form factor (embedded) configurations of the JTRS radio family.

Defense Information Systems Network - Next Generation (DISN-NG)

Prior to the implementation of the GIG, the DISN, the DoD's primary terrestrial transport system, was a collection of non-integrated dedicated transport subsystems. The subsystems were put in place to meet individual user requirements over the years and have grown to support a large customer base of military bases and installations worldwide. Although the name connotes a single network, the DISN actually consists of a number of separate networks and thousands of point-to-point leased circuits acquired to meet user's needs. The DISN supports the following six *DISN services*:

1. Unclassified internet protocol (IP) (NIPRNET).
2. Secret IP (SIPRNET).
3. Top-secret IP joint world wide intelligence communications system (JWICS).
4. Unclassified command and control (C2) voice service (Defense-Switched Network).
5. Video services, a secure command and control conferencing system for senior leaders (Defense Video Services – Global).
6. Secure C2 voice service and conferencing services (Defense Red-Switched Network).

The non-optimized attributes of the DISN resulted from decentralized budgeting issues, limitations on infrastructure investments, and technology limitations. The departments approach to terrestrial networks transformed dramatically in 2003 when the department was able to start a major investment to procure a fiber based Wide Area Network (WAN) transport system called the GIG Bandwidth Expansion program (GIG-BE).

The GIG-BE program provides a global fiber optic backbone as the primary terrestrial segment of an integrated communications transport architecture. GIG-BE creates a ubiquitous, robust, trusted network where terrestrial bandwidth availability will no longer be a constraint in providing, sharing, and using information. The GIG-BE connects 86 of the department's most important locations such as intelligence centers and force projection bases – those with the highest bandwidth requirements. It allows the department to reap the full benefits of other transformational investments in surveillance *reach-back* analysis, sensor-to-shooter integration, information and intelligence collaboration, and enterprise computing. GIG-BE's technical basis focuses on an IP network with significantly expanded bandwidth availability, where large quantities of information can be distributed, analyzed, and shared in new, more effective ways.

Now that the GIG-BE network is in operational status, the second step toward transformation is to extend the transport capabilities of the fiber WAN to the rest of the DoD and converge to a single network for all users. The migration of the DoD to an integrated net-centric terrestrial transport system will depend on the DISN-NG program. The goal is to have a truly integrated and converged IP network. The transition has started with the consolidation of IP based networks. Other service transitions efforts are focusing on voice-over IP and the transition of video services to IP, with a goal of full network convergence.

The final piece of the terrestrial infrastructure transformation is the link from terrestrial networks to satellites. The DoD teleport is linked to the DoD's fiber infrastructure and acts as the primary SATCOM gateway, providing access to numerous military and commercial satellites. The teleport provides tactical forces around the world with the ability to access and exploit the vast resources on the terrestrial net via satellites, providing a wide range of capabilities through global up and down links.

Conclusion

The foundation for U.S. and coalition net-centric capability is the transformational communications network. Without this vital *transport* system the warfighter/user information cannot support our operations. The heart of the DoD's long term integrated investment strategy is a network of systems providing greatly enhanced capabilities for all aspects of U.S. national security activities. This includes persistent surveillance, distribution of detailed actionable intelligence, and support to precision strike. It also includes secure, protected, NOTM communications capability to support enhanced command and control of forces. This capability supports not only tactical forces, but also all other national security operations, including logistics, business operations, and intelligence functions. Several key investment programs, including TSAT, JTRS, and DISN-NG will be integrated to provide an end-to-end transformational communications capability to enable net-centric operations and vastly improve future DoD operations.◆

About the Author

Dr. Troy Meink is currently the Director, Communications Office of the Assistant Secretary of Defense/ Networks and Information Integration and is responsible for oversight and policy of communications programs within the Department of Defense. Previously, Meink was the Transformation Satellite Communications System program director at the Military Satellite Communications Joint Program Office, Space and Missile Systems Center. He has a doctorate degree in aeronautical and astronautical engineering from Ohio State University.

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